Cruise Report HE-249, 8. – 16. May 2006

Re.: 05/23541, 9 February 2006, NPD 05/993 /WeS

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Aim

This cruise was a follow-up of cruise HE-238 on the same track in September 2005 and focused on plankton dynamics in spring in the North Sea with a special emphasis on the role of the bacterioplankton and bacteria at the oxic sediment surface. We aimed to study the dynamics of phytoplankton at various conditions, i.e. bloom versus non-bloom conditions, and spatio-temporal patterns in the North Sea. We were particularly interested into two major bacterioplankton groups in the North Sea, the SAR11 clade and a narrow cluster of the *Roseobacter* group (RCA cluster).

Cruise track, stations, sampling and parameters studied.

As outlined in Figs. 1 and 2, the cruise track went from Bremerhaven to 59 °N and back south. The track was basically identical to that of cruise HE-238. We were lucky in hitting a situation with a pronounced plankton bloom in the southern North Sea and decreasing chlorophyll concentrations towards the northern part. In total 27 stations were visited at which various hydrographical, chemical and biological measurements, mainly in the water column, were carried out (see Tables on station overview and parameter overview).

Results

We encountered the typical spring phytoplankton with a pronounced bloom in the southern North Sea, dominated by diatoms and further north, at decreasing chlorophyll a concentrations, relatively more dinoflagellates and some green algae were recorded. In the very north. Close to the Norwegian coast, high chlorophyll values also indicated a phytoplankton bloom. The zooplankton was always dominated by copepods but at a few stations quite a few cladocerans were present as well as meroplanktonic larvae and pelagic tunicates. The patterns of suspended matter and chlorophyll a from south to north is depicted on Fig. 3.

First results indicate that the SAR11 clade constituted between up to 20% of the total and the RCA cluster up to 10% of total bacterioplankton. Highest fractions both of the SAR11 clade and the RCA cluster appeared at the northern fringe and in the Wadden Sea.
These data were obtained by quantitative real time PCR with appropriate primer systems specific for the respective target groups.

Conclusions and outlook

This cruise complements that of September 2005 and adds to the early fall situation the spring aspect to this study of the bacterioplankton dynamics in the North Sea. It showed that both target groups of the bacterioplankton are also prominent components of the bacterioplankton in spring and thus extends the findings of the fall cruise to the spring situation.

Acknowledgements:

We are most grateful to the captain and crew of RV Heincke for their excellent support on shipboard, to the Deutsche Forschungsgemeinschaft for financial support and to the responsible authorities of Denmark and Norway for giving us the permission to do research in the economic zones of their countries.

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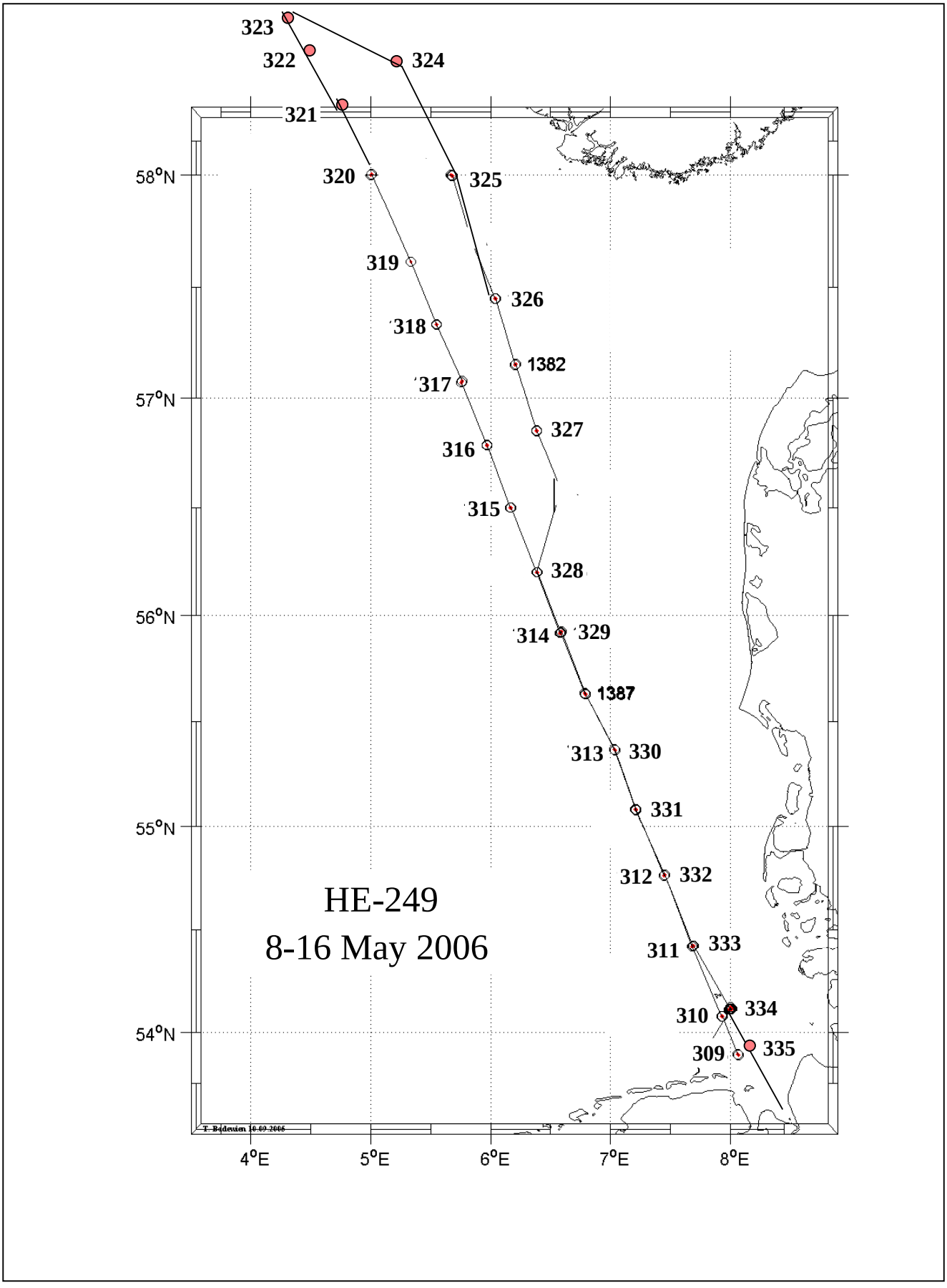

Fig. 1: Cruise track HE-238

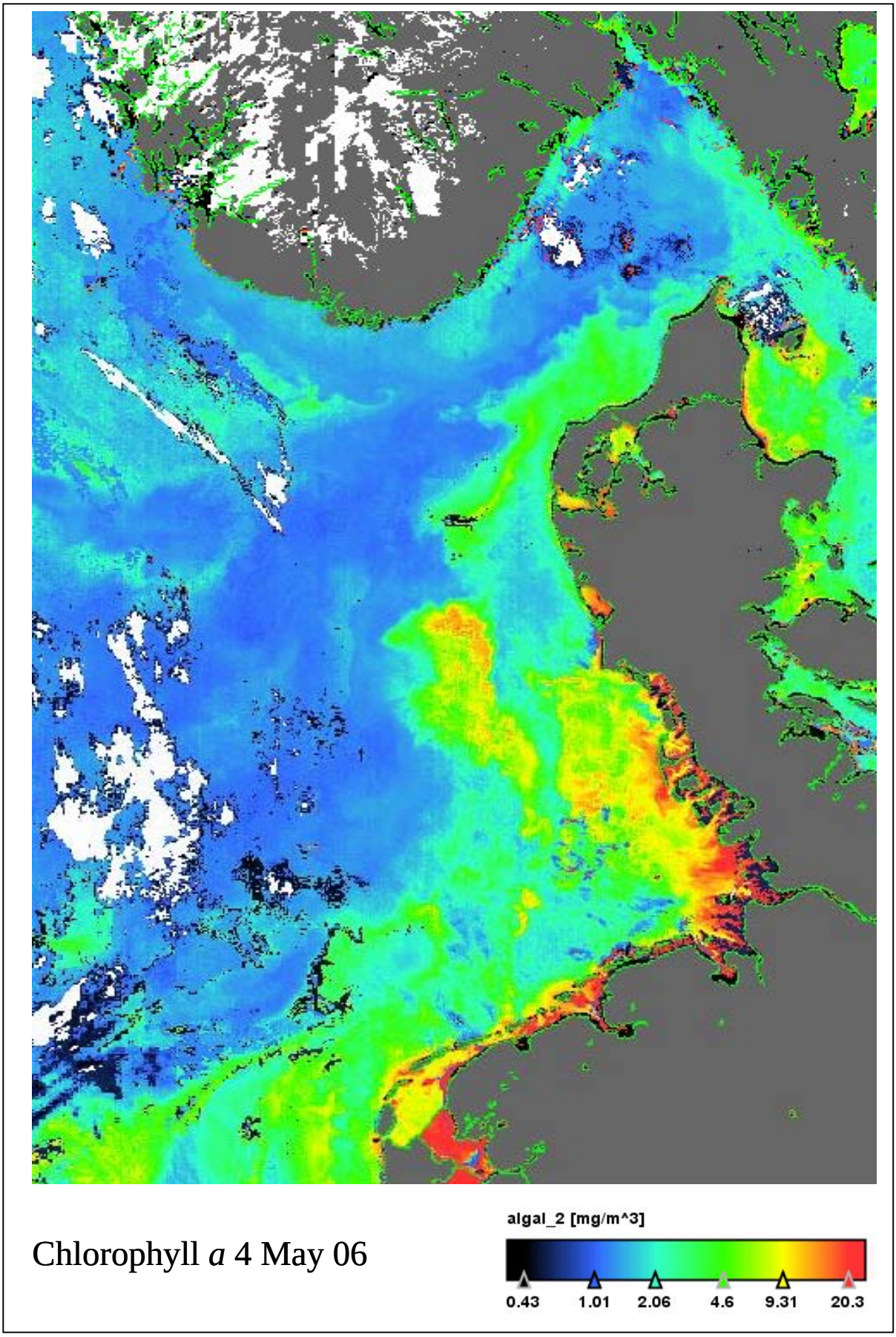

Fig. 2: Satellite image of chlorophyll distribution in the North Sea on 4 May 2006 (Courtesy of GKSS).

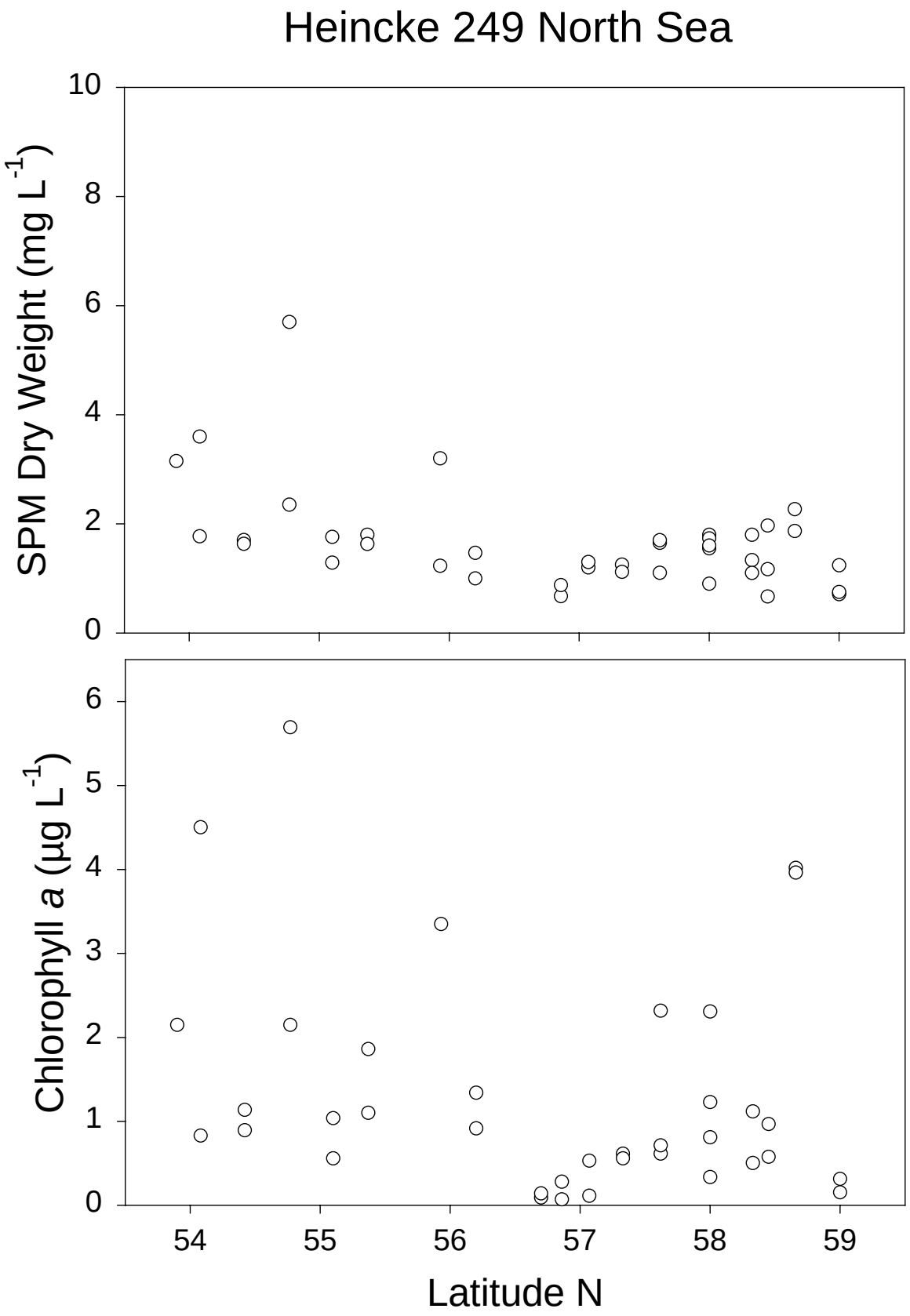

Fig. 3: Suspended particulate matter (SPM, upper panel) and chlorophyll *a* (lower panel) on the cruise track during cruise HE-249. Given are values of the mixed layer (0 m to 20 m depth).

Cruise Heincke-249, 8.- 16. May 2006

Station overview

Station	Date	Time (UTC)	Position N	Position E	Temp 0 m (°C)	Secchi (m)	Depth (max) (m)
309	08.05.	11:30	53° 53.736’	08° 04.050’	10.6	nd	12
310	08.05.	14:06	54° 04.946’	07° 56.069’	9.2	nd	32.5
311	09.05.	06:20	54° 25.328’	07° 40.980’	8.4	6.8	22
312	09.05.	09:43	54° 45.879’	07° 26.778’	8.3	6.5	20
313	09.05.	14:15	55° 22.049’	07° 02.049’	(?) 12.9	6.0	26
314	10.05.	05:45	55° 54.949’	06° 34.832’	9.1	3.0	37
315	10.05.	10:45	56° 29.942’	06° 10.105’	9.1	20.9	34
316	10.05.	13:21	56° 41.907’	05° 58.039’	9.7	20.5	52
317	10.05.	16:30	57° 04.114’	05° 45.048’	9.4	26.0	44.6
318	11.05.	06:15	57° 19.952’	05° 33.090’	8.2	15.0	71
319	11.05.	08:20	57° 37.078’	05° 20.060’	9.0	14.0	86
320	11.05.	11:45	58° 00.227’	05° 00.225’	9.1	9.0	127
321	11.05.	15:49	58° 20.056’	04° 43.005’	8.8	13.0	292
322	12.05.	05:45	58° 39.977’	04° 26.038’	8.9	15.0	260
323	12.05.	09:48	58° 59.715’	04° 09.911’	8.7	17.5	287
234	12.05.	16:40	58° 26.974’	05° 15.196’	9.5	9.0	309 *
325	13.05.	05:49	57° 59.968’	05° 39.930’	9.3	10.0	258 *
326	13.05.	12:30	57° 37.038’	06° 02.509’	9.4	13.0	84
327	13.05.	17:00	56° 51.273’	06° 23.149’	8.6	15.0	48
328	14.05.	05:45	56° 12.011’	06° 23.094’	9.0	7.0	40
329	14.05.	07:55	55°55.488’	06° 35.449’	9.5	4.5	37
330	14.05.	12:15	55° 22.147’	07° 01.951’	9.8	3.5	27
331	14.05.	14:42	55° 06.111’	07° 11.945’	11.2	5.5	25
332	14.05.	17:25	54° 46.285’	07° 27.147’	11.6	5.0	19
333	15.05.	05:45	54° 25.409’	07° 40.980’	11.8	6.5	20
334	15.05.	8:20	54° 04.865’	07° 56.066’	10.6	3.0	33
335	15.05.	10:10	53° 53.874’	08° 03.156’	9.0	5.0	14

* Extreme salinity gradient 0-10 m: 27.5->34‰

Overview of sampling depths in the water column, sediment und net tow 55 µm

Station	Date	Sampling depths (m)		Net tow Phytoplankton	Net tow Zooplankton
		Water column	Sediment		
309	08.05.	1, 10	-	Diatoms, diverse, dominance of Rhizosolenia, break down of a bloom	Copepods
310	08.05.	1, 10, 20	+	Diatoms, Rhizosolenia, break down of a bloom	Copepods
311	09.05.	8, 18	-	Diatoms, Rhizosolenia, break down of a bloom	Cladocerans (Evadne) and Copepods
312	09.05.	8, 18	+	fewer diatoms, Rhizosolenia dominate	Copepods
313	09.05.	4, 12, 22	+	fewer diatoms, Rhizosolenia dominate	Copepods
314	10.05.	2, 8, 20	+	Diatoms (Coscinodiscus wailesii), Ceratium spp., rather diverse	Nauplii
315	10.05.	5, 15, 30	+	Diatoms (Coscinodiscus granii, few Rhizosolenia), diverse Ceratium	Adult copepods and Nauplii
316	10.05.	5, 20, 35	-	Diatoms (Coscinodiscus granii), diverse Ceratium	Adult copepods and Nauplii, tini gellyfish (?)
317	10.05.	5, 15, 35	-	Diatoms (Coscinodiscus granii, Rhizosolenia), diverse Ceratium, Protoperidinium, Phaeocystis	many Echinoidea-Pluteuslarvae, Calanoidea, Chaetognatha, few Euphausid larvae
318	11.05.	5, 15, 35	-	Phaeocystis, Leptocylindrus, Rhizosolenia, Ceratium spp., Protoperidinium, Halosphaera	Diverse Copepods, Chaetognaths, many Oikopleura
319	11.05.	10, 37, 55	+	Phaeocystis, Leptocylindrus, Rhizosolenia, Chaetoceros, Ceratium spp., Protoperidinium, Dinophysis, Halosphaera	Diverse Copepods, Echinoidea-Pluteuslarvae,, many Fritillaria

Station	Date	Sampling depths (m)		Net tow Phytoplankton	Net tow Zooplankton
		Water column	Sediment		
320	11.05.	10, 20, 30, 45, 80	+	Spring bloom: Phaeocystis, Leptocylindrus, Rhizosolenia, Chaetoceros, Ceratium spp., Protoperidinium, Halosphaera	few Copepods, Oikopleura, Fritillaria
321	11.05.	10, 20, 30, 60, 90	-	Spring bloom: Phaeocystis, Leptocylindrus, Rhizosolenia spp., Viele Ceratium spp., Protoperidinium,, Dinophysis	Diverse Copepods, Oikopleura
322	12.05.	10, 20, 30, 50, 100	+	Spring bloom: Phaeocystis, diverse Diatomeen (Leptocylindrus, Rhizosolenia spp., Chaetoceros spp.,, Pseudonitzschia pungens, Guinardia flaccida, few Ceratium spp., Protoperidinium,, Dinophysis	Diverse Copepods, Oikopleura, Fritillaria, Cirriped larvae, Chaetognaths, Ctenophors, Radiolarians, few Echinoidea-Larvae
323	12.05.	10, 20, 30, 50, 100	+	few Phytoplankton, Phaeocystis, Ceratium spp., Protoperidinium, Dinophysis, Leptocylindrus	Diverse Copepods, Oikopleura, many Medusae, Ctenophors, Larvae of: Echinoidea, Bryozoans, Polychaets, Cirripeds,
324	12.05.	5, 10, 20, 30, 50, 100	+	few Phytoplankton, Ceratium spp., no Diatoms	many Copepods, Cirriped larvae, Appendicularians, Echinoidea-Larvae, Medusae,
325	13.05.	5, 15, 30, 50, 100	+	few Phytoplankton, Ceratium spp., no Diatoms	many Copepods, Cirriped larvae, Oikopleura, Chaetognaths, Echinoidea-Larvae, Medusae, gastropod larvae
326	13.05.	10, 35, 60	-	Phaeocystis, Ceratium spp., Protoperidinium,Dinophysis, Leptocylindrus, Chaetoceros, Rhizosolenia, Guinardia flaccida	many Copepods, Oikopleura, Chaetognaths, Echinoidea-Larvae,
327	13-05.	15, 30	-	Ceratium spp., very few Diatoms	few Copepods, many Echinoidea-Larvae, Chaetognats

Station	Date	Sampling depths (m)		Net tow Phytoplankton	Net tow Zooplankton
		Water column	Sediment		
328	14.05.	5, 15	-	Coscinodiscus granii+wailesii, Chaetoceros spp., Silicoflagellat (Dictyocha speculum), Ceratium tripos, Dynophysis	Quite a few Copepods, Cladocerans (Evade normanii)
329	14.05.	10, 25	-	Coscinodiscus wailesii, Chaetoceros spp., Guinardia flaccida, Ceratium spp., Dynophysis	many Echinoderm-Bippinaria-Larvae, (Echinoidea, starfish), few Copepods
330	14.05.	5, 20	-	Coscinodiscus wailesii, Guinardia flaccida, Brockmanniella, Rhizosolenia, Ceratium horridum,	Copepods, Cladocerans (Evadne), few Echinoidea larvae
331	14.05.	5, 15	-	Coscinodiscus wailesii, Ceratium horridum, fusus	Copepods, Cladocerans (Evadne), many Ctenophors, Bipinnaria larvae,
332	14.05.	0, 15, 25	-	Diverse diatoms (Coscinodiscus wailesii, Rhizosolenia spp., Chaetoceros spp., Guinardia flaccida, Thalassiosira rotula, Ditylum brightwelli	Copepods, few Cladocerans, Bipinnaria larvae, Echinoidea-larvae, Polychaet larvae, many Ctenophors
333	15.05.	0, 10	-	Very diverse diatoms (Coscinodiscus wailesii, Rhizosolenia spp., Chaetoceros spp., Guinardia flaccida, Ditylum brightwelli, Thalassionema nitzschioides, Asterionellopsis glacialis	Copepods, Echinoderm larvae, Ctenophors
334	15.05.	5, 20	-	dense spring bloom, very diverse diatoms, all species typical for the North Sea present.	few Copepods and Polychaet larvae
335	15.05.	5	-	dense spring bloom, very diverse diatoms, all species typical for the North Sea present.	Wenige Copepoden und Polychaetenlarven

Parameter overview water column

Station	Date	SPM	Chl	C/N	DNA	FISH	BP/AA/ Glc	MAR-FISH	Bact	Phyto	DOC	DAA/ DCHO	
309	08.05.	+	+	+	+	+	+	+	+	+	+	+	
310	08.05.	+	+	+	+	+	+	+	+	+	+	+	
311	09.05.	+	+	+	+	+	+	-	+	+	+	+	
312	09.05.	+	+	+	+	+	+	-	+	+	+	+	
313	09.05.	+	+	+	+	+	+	+	+	+	+	+	
314	10.05.	+	+	+	+	+	+	+	+	+	+	+	
315	10.05.	+	+	+	+	+	+	+	+	+	+	+	
316	10.05.	+	+	+	+	+	+	+	+	+	+	+	
317	10.05.	+	+	+	+	+	+	-	+	+	+	+	
318	11.05.	+	+	+	-	-	-	-	+	-	-	-	
319	11.05.	+	+	+	+	+	+	-	+	-	-	-	
320	11.05.	+	+	+	+	+	+	+	+	+	+	+	
321	11.05.	+	+	+	+	+	+	-	+	+-	+	-	
322	12.05.	+	+	+	+	+	+	+	+	+	+	+	
323	12.05.	+	+	+	+	+	+	+	+	+	+	+	
324	12.05.	+	+	+	+	+	+	+	+	+	+	+	
325	13.05.	+	+	+	+	+	+	+	+	+	+	+	
326	13.05.	+	+	+	+	+	+	+	+	+	+	+	
327	13.05.	+	+	+	+	+	+	+	+	+	+	+	
328	14.05.	+	+	+	+	+	+	+	+	-	+	+	
329	14.05.	+	+	+	+	+	+	+	+	+	+	+	
330	14.05.	+	+	+	+	+	+	+	+	+	+	+	
331	14.05.	+	+	+	-	-	-	-	+	+	+	+	
332	14.05.	+	+	+	+	+	+	+	+	+	+	+	
333	15.05.	+	+	+	+	+	+	+	+	+	+	+	
334	15.05.	+	+	+	+	+	+	+	+	+	+	+	
335	15.05	+	+	+	+	+	+	+	+	+	+	+	

Parameter overview sediment

Station	Date	POC	FISH	DNA	Bacteria	
310	08.05.	+	+	+	+	
312	09.05.	+	+	+	+	
314	10.05.	+	+	+	+	
315	10.05.	+	+	+	+	
319	11.05.	+	+	+	+	
320	11.05.	+	+	+	+	
322	12.05.	+	+	+	+	
323	12.05.	+	+	+	+	
324	12.05.	+	+	+	+	

CRUISE SUMMARY REPORT	*FOR COLLATIMG CENTRE USE* **Centre: DOD** **Ref. No.:** Is data exchange restricted ☐ Yes ☐ In part ☐ No

SHIP enter the full name and international radio call sign of the ship from which the data were collected, and indicate the type of ship, for example, research ship; ship of opportunity, naval survey vessel; etc.

Name: Heincke **Call Sign: HE**

Type of ship: Research Vessel

CRUISE NO. / NAME HE-249

enter the unique number, name or acronym assigned to the cruise (or cruise leg, if appropriate).

CRUISE PERIOD start **(set sail)** **08/05/2006** **day/ month/ year** to **16/05/2006** **day/ month/ year** end **(return to port)**

PORT OF DEPARTURE (enter name and country) **Bremerhaven, Germany**

PORT OF RETURN (enter name and country) **Bremerhaven, Germany**

RESPONSIBLE LABORATORY enter name and address of the laboratory responsible for coodinating the scientific planning of the cruise

Name: ICBM, University of Oldenburg

Address: POBox 2503, D-26111 Oldenburg

Country: Germany

CHIEF SCIENTIST(S) enter name and laboratory of the person(s) in charge of the scientific work (chief of mission) during the cruise.

Dr. Meinhard Simon, ICBM, University of Oldenburg

OBJECTIVES AND BRIEF NARRATIVE OF CRUISE enter sufficient information about the purpose and nature of the cruise so as to provide the context in which the report data were collected.

To study bacterioplankton dynamics in the the North Sea

PROJECT (IF APPLICABLE) if the cruise is designated as part of a larger scale cooperative project (or expedition), then enter the name of the project, and of organisation responsible for co-ordinating the project.

Project name:

Coordinating body:

PRINCIPAL INVESTIGATORS: Enter the name and address of the Principal Investigators responsible for the data collected on the cruise and who may be contacted for further information about the data. (The letter assigned below against each Principal Investigator is used on pages 2 and 3, under the column heading 'PI', to identify the data sets for which he/she is responsible)

Dr. Meinhard Simon

MOORINGS, BOTTOM MOUNTED GEAR AND DRIFTING SYSTEMS

This section should be used for reporting moorings, bottom mounted gear and drifting systems (both surface and deep) deployed and/or recovered during the cruise. Separate entries should be made for each location (only deployment positions need be given for drifting systems). This section may also be used to report data collected at fixed locations which are returned to routinely in order to construct 'long time series'.

PI See top of page.	APPROXIMATE POSITION LATITUDE deg	min	N/S	LONGITUDE deg	min	E/W	DATA TYPE enter code(s) from list on cover page.	DESCRIPTION Identify, as appropriate, the nature of the instrumentation the parameters (to be) measured, the number of instruments and their depths, whether deployed and/or recovered, dates of deployments and/or recovery, and any identifiers given to the site.
								Please continue on separate sheet if necessary

SUMMARY OF MEASUREMENTS AND SAMPLES TAKEN

Except for the data already described on page 2 under 'Moorings, Bottom Mounted Gear and Drifting Systems', this section should include a summary of all data collected on the cruise, whether they be measurements (e.g. temperature, salinity values) or samples (e.g. cores, net hauls).

Separate entries should be made for each distinct and coherent set of measurements or samples. Different modes of data collection (e.g. vertical profiles as opposed to underway measurements) should be clearly distinguished, as should measurements/sampling techniques that imply distinctly different accuracy's or spatial/temporal resolutions. Thus, for example, separate entries would be created for i) BT drops, ii) water bottle stations, iii) CTD casts, iv) towed CTD, v) towed undulating CTD profiler, vi) surface water intake measurements, etc.

Each data set entry should start on a new line – it's description may extend over several lines if necessary.

NO, UNITS : for each data set, enter the estimated amount of data collected expressed in terms of the number of 'stations'; miles' of track; 'days' of recording; 'cores' taken; net 'hauls'; balloon 'ascents'; or whatever unit is most appropriate to the data. The amount should be entered under 'NO' and the counting unit should be identified in plain text under 'UNITS'.

PI see page 2	NO see above	UNITS see above	DATA TYPE Enter code(s) from list on cover page	DESCRIPTION Identify, as appropriate, the nature of the data and of the instrumentation/sampling gear and list the parameters measured. Include any supplementary information that may be appropriate, e. g. vertical or horizontal profiles, depth horizons, continuous recording or discrete samples, etc. For samples taken for later analysis on shore, an indication should be given of the type of analysis planned, i.e. the purpose for which the samples were taken.
A	**57**	**station**	**H09**	**see attached Table and map**
A	**57**	**station**	**H10**	**see attached Table and map**
A	**36**	**station**	**B02**	**see attached Table and map**
A	**37**	**station**	**B71**	**see attached Table and map**
A	**28**	**station**	**B06**	**see attached Table and map**
A	**27**	**station**	**B72**	**see attached Table and map**
A	**37**	**station**	**B03**	**see attached Table and map**
A	**32**	**station**	**B07**	**see attached Table and map**
A	**12**	**station**	**B16**	**see attached Table and map**
B	**28**	**station**	**H30**	**see attached Table and map**
B	**28**	**station**	**H24**	**see attached Table and map**
B	**28**	**station**	**H26**	**see attached Table and map**
A	**28**	**station**	**B08**	**see attached Table and map**
A	**28**	**station**	**B09**	**see attached Table and map**
				Please continue on separate sheet if necessary

TRACK CHART: You are strongly encouraged to submit, with the completed report, an annotated track chart illustrating the route followed and the points where measurements were taken.	**Insert a tick(✔) in this box if a track chart is supplied** ☒

GENERAL OCEAN AREA(S): Enter the names of the oceans and/or seas in which data were collected during the cruise – please use commonly recognised names (see, for example, International Hydrographic Bureau Special Publication No. 23, 'Limits of Oceans and Seas').

North Sea

SPECIFIC AREAS: If the cruise activities were concentrated in a specific area(s) of an ocean or sea, then enter a description of the area(s). Such descriptions may include references to local geographic areas, to sea floor features, or to geographic coordinates.
Please insert here the number of each square in which data were collected from the below given chart

215

GEOGRAPHIC COVERAGE - INSERT 'X' IN EACH SQUARE IN WHICH DATA WERE COLLECTED

see above